

WHAT IS CLAIMED IS:

- 1        1. A method of making nanoparticles of a copper/zinc (Cu/Zn) alloy comprising:  
2              mounting one or more targets in a chamber;  
3              vaporizing material from each of the one or more targets by subjecting each of the  
4              one or more targets to a beam of laser energy to form a vapor; and  
5              condensing the vapor to form the Cu/Zn alloy nanoparticles.
  
- 1        2. The method according to claim 1, wherein the one or more targets comprises a  
2              single target comprising a Cu/Zn alloy.
  
- 1        3. The method according to claim 2, wherein the single target comprises a Cu/Zn  
2              alloy wrapped in zinc.
  
- 1        4. The method according to claim 2, wherein the single target is a compact  
2              comprising copper and zinc powders or a compact comprising brass and zinc powders.
  
- 1        5. The method according to claim 1, wherein the Cu/Zn alloy nanoparticles have an  
2              average particle size of less than about 20 nm.
  
- 1        6. The method according to claim 1, wherein the laser is a YAG-Nd laser and  
2              wherein the emission from the laser comprises the second harmonic at a wavelength of 532 nm.
  
- 1        7. The method according to claim 1, wherein the laser energy is pulsed.
  
- 1        8. The method according to claim 7, wherein the pulses of laser energy have a  
2              duration of about 10 nanoseconds.

1           9. The method according to claim 7, wherein each pulse of laser energy delivers  
2 from 20 - 40 mJ of energy to the target.

1           10. The method according to claim 1, wherein the nanoparticles are formed in the  
2 presence of an electric field and wherein the nanoparticles comprise filaments, nanowires or  
3 nanotubes.

1           11. The method according to claim 10, wherein the nanoparticles have an aspect ratio  
2 greater than 1.

1           12. The method according to claim 10, wherein the electric field is applied at 30 to  
2 300 V/cm.

1           13. The method according to claim 1, wherein the vaporization and condensing are  
2 carried out in a diffusion cloud chamber.

1           14. The method according to claim 13, wherein the diffusion cloud chamber  
2 comprises an upper portion and a lower portion and wherein the upper portion is maintained  
3 at a lower temperature than the lower portion such that the nanoparticles condense in the  
upper portion.

1           15. The method according to claim 1, wherein an inert carrier gas or a reactive  
2 mixture comprising an inert carrier gas and a reactive gas is added to the chamber.

1           16. The method according to claim 15, wherein the inert carrier gas is helium or  
2 argon.

1           17. The method according to claim 15, wherein the reactive mixture comprises an  
2 inert gas and isobutene.

1        18. The method according to claim 15, wherein the reactive mixture comprises  
2        oxygen and an inert gas and wherein the nanoparticles comprise one or more oxides of  
3        copper and/or zinc.

1        19. The method according to claim 18, wherein the nanoparticles comprising one or  
2        more oxides of copper and/or zinc are CuO, ZnO, or Cu<sub>2</sub>O.

1        20. The method according to claim 1, wherein the nanoparticles comprise  
2        intermetallic compounds of copper and zinc.

1        21. The method according to claim 20, wherein the intermetallic compounds comprise  
2        Cu<sub>5</sub>Zn<sub>8</sub> and/or CuZn<sub>5</sub>.

1        22. The method according to claim 1, wherein the one or more targets comprises a  
2        first target comprising copper and a second target comprising zinc, the method further  
3        comprising steps of:

4              splitting the beam of laser energy into a first beam and a second beam of laser  
5        energy;

6              subjecting the first target to the first beam of laser energy to form a first vapor;

7              subjecting the second target to the second beam of laser energy to form a second  
8        vapor;

9              mixing the first and second vapors; and

10          condensing the mixed vapors to form the Cu/Zn alloy nanoparticles.

1        23. The method according to claim 1, wherein the beam of laser energy is moved  
2        relative to the one or more targets.

1        24. The method according to claim 1, wherein pressure in the chamber is maintained  
2        in the range of  $10^{-3}$  to  $10^4$  torr during the vaporization step.

1        25. The method according to claim 1, further comprising maintaining a temperature  
2        gradient in the chamber during the vaporization step.

1        26. The method according to claim 1, wherein pressure in the chamber during  
2        vaporization is maintained above atmospheric pressure.  
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1        27. A method of making nanoparticles of copper (Cu) comprising:  
2              mounting one or more targets in a chamber, at least one of the targets comprising  
3              a first target comprising copper;  
4              vaporizing material from at least one of the one or more targets by subjecting the  
5              at least one target to a beam of laser energy to form a first vapor; and  
6              condensing the first vapor to form the Cu nanoparticles.

1        28. The method according to claim 1, further comprising steps of:  
2              optionally mixing the first vapor and a second vapor,  
3              wherein the second vapor is an inert carrier gas or a reactive mixture comprising an  
4              inert carrier gas and a reactive gas and the Cu nanoparticles comprise one or more oxides of  
5              copper.

1        29. A method of making nanoparticles of zinc (Zn) comprising:  
2              mounting one or more targets in a chamber, at least one of the targets comprising  
3              a first target comprising zinc;  
4              vaporizing material from at least one of the one or more targets by subjecting the  
5              at least one target to a beam of laser energy to form a first vapor; and  
6              condensing the first vapor to form the Zn nanoparticles.

1       30. The method according to claim 29, further comprising steps of:  
2             optionally mixing the first vapor and a second vapor,  
3             wherein the second vapor is an inert carrier gas or a reactive mixture comprising an  
4             inert carrier gas and a reactive gas and the Zn nanoparticles comprise one or more oxides of  
5             zinc.

1       31. A nanosized particle of Cu/Zn alloy having an average particle size of  $\leq$  20 nm,  
2       wherein the nanosized particle is condensed from a laser vaporized material.  
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1       32. The nanosized particle of claim 31, wherein the average particle size is less than  
2       about 20 nm.

1       33. The nanosized particle of claim 31, wherein the nanosized particles comprise one  
2       or more intermetallic compounds of copper and zinc.

1       34. The nanosized particle of claim 33, wherein the intermetallic compounds comprise  
2        $Cu_5Zn_8$  and/or  $CuZn_5$ .

1       35. A nanosized particle produced by condensation of material from a laser  
2       vaporization of first and/or second targets, wherein a first target comprises copper and a  
3       second target comprises zinc.

1       36. The nanosized particles of claim 35, wherein the nanosized particles comprise one  
2       or more intermetallic compounds of copper and zinc.

1       37. The nanosized particle of claim 36, wherein the intermetallic compounds comprise  
2        $Cu_5Zn_8$  and/or  $CuZn_5$ .

1        38. A supported catalytic structure comprising:  
2              a catalytic structure; and  
3              a catalyst,  
4        wherein the catalyst comprises a plurality of nanoparticles of Cu, Zn or Cu/Zn formed  
5        by the process of laser vaporization with controlled condensation.